Aerosol retrievals from the ACEPOL campaign

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We present aerosol retrieval results from the Aerosol Characterization from Polarimeter and Lidar (ACEPOL) campaign, which was a joint initiative between NASA and SRON – Netherlands Institute for Space Research. The campaign took place in October–November 2017 over the western part of the United States. During ACEPOL six different instruments were deployed on the NASA ER-2 high altitude aircraft, including four Multi-Angle Polarimeters (MAPs): SPEX airborne, the Airborne Hyper Angular Rainbow Polarimeter (AirHARP), the Airborne Multi-angle SpectroPolarimeter Imager (AirMSPI), and the Research Scanning Polarimeter (RSP). Also, two lidars participated: the High Spectral Resolution Lidar -2 (HSRL-2) and the Cloud Physics Lidar (CPL). Flights were conducted mainly for scenes with low aerosol load over land but also some cases with higher AOD were observed. We perform aerosol retrievals from SPEX airborne, RSP (410–865 nm range only), and AirMSPI using the SRON aerosol retrieval algorithm and compare the results against AERONET and HSRL-2 measurements (for SPEX airborne and RSP). All three MAPs compare well against AERONET for the Aerosol Optical Depth (AOD) (Mean Absolute Error (MAE) between 0.014–0.024 at 440 nm). For the fine mode effective radius the MAE ranges between 0.010–0.021 micrometers. For the comparison with HSRL-2 we focus on a day with low AOD (0.02-0.14 at 532 nm) over the California Central Valley, Arizona and Nevada (26 October) and a flight with high AOD (including measurements with AOD > 1.0 at 532 nm) over a prescribed forest fire in Arizona (9 November). For the day with low AOD the MAE in AOD (at 532 nm) with HSRL-2 are 0.014 and 0.022 for SPEX and RSP, respectively, showing the capability of MAPs to provide accurate AOD retrievals for the challenging case of low AOD over land. For the retrievals over the smoke plume also a reasonable agreement in AOD between the MAPs and HSRL-2 was found (MAE 0.088 and 0.079 for SPEX and RSP, respectively), despite the fact that the comparison is hampered by large spatial variability in AOD throughout the smoke plume. Also a good comparison is found between the MAPs and HSRL-2 for the aerosol depolarization ratio (a measure for particles sphericity) with MAE of 0.023 and 0.016 for SPEX and RSP, respectively. Finally, SPEX and RSP agree very well for the retrieved microphysical and optical properties of the smoke plume.

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